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A SYSTEMS MODEL OF BEHAVING ORGANISMS AND PERSONS: Implications to Behavior Change in Counseling[1]

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Many psychological helping professions intend to bring about behavioral change in clients through conversation. If behavior is defined as a person's interchange with his environment, help giving is concerned with changes in the client's interchange with his environment. In verbal counseling and Psychotherapy, the verbal interchange "in the office" is intended to lead to behavioral change outside the office. Thus, symbolism or verbal behavior must be explored as well as how verbal interchange can lead to desired behavioral changes. The purpose of this paper is to present a model of the behaving organism, develop a conceptual framework for describing and accounting for behavior, and explore symbolism and behavior change in the verbal interview.

In this paper, the behaving organism is approached from the framework of field theory. Field theory was introduced to psychology by Kurt Lewin (1935) and is so endemic to the physical sciences that introductory physics texts do not mention it--the entire subject matter is cast in the field theory framework (Halliday & Resnick, 1970). Basically, field theory makes three assertions: (1) All events are a consequence of the interaction of the characteristics of the behaving entity and the characteristics of the field it occupies; (2) All events are consequences of variables acting contemporaneously with the event; (3) All events are lawful or completely determined (Strong, 1973). The model of the behaving organism is drawn from the concepts of general system theory which Von Bertalanffy (1968) and Ashby (1960) have applied to biological and behavioral phenomena. In this paper, their concepts are combined with Kliv and Valach's (1967) concepts of cybernetic modeling to develop a general model of a behaving organism and a framework for describing behavior and behavior change.

The Behaving Organism

Open Systems, Steady States and Evolution

An organism can be conceptualized as a system of interconnected elements which is distinguishable from its field or environment. Figure 1 below illustrates a system with elements $E=e_1$ and e_2 and interconnections $P=p_{12}$ and p_{21}. If we denote the system O, then the system is defined as $O=(E,P)$. The system in figure 1 is "closed" in that the

Insert Figure 1 about here

elements of the system relate to each other but not to their field. An organismic system is an "open" system that receives input from its field and delivers output to its field (i.e. it is connected to its field). Figure 2 illustrates an open system

Insert Figure 2 about here

which connects with its environment through p_{3e} and p_{e3}. Note that the system in Figure 2 can be considered an open system only if we conceive of the environment (element e_e) as outside the system. We can distinguish the system from the environment because two of the three elements (e_1 and e_2) do not connect with the environment e_e while all three of the system elements (e_1, e_2, and e_3) interrelate to each other.

Many physical systems are open with respect to having input from and output to their surrounding field or environment. Organic systems differ from all other physical systems in that they do not experience entrophy while they live. Entrophy is the tendency of open systems in a field to approach maximum dissipation of energy to a point of indifferentiation from their field. For example, a burning candle, distinguishable from its field by its energy potential, tends to dissipate its energy into its surrounding environment until the energy is diffused into its surrounding environment, the end point of which is the disappearance of the candle. Liekwise, a heated pool diffuses its heat into its environment until it is indistinguishable from its environment in temperature. A concentration of gas diffuses into its field until the concentration is no longer distinguishable, the mixture of gases being similar throughout the field. Organic systems do not experience entrophy while they live. That is, organic systems demonstrate negative entrophy through growth; they become increasingly differentiated. Organic systems do not experience entrophy because they control their input from their environment and transform that input so as to maintain (and increase) their internal organization. Von Bertalanffy (1968, p.160) defines the organic system's self maintenance as a chemical condition of a steady state. Essentially a steady state is a balanced chemical transformation of input that maintains a constant level of substances needed to maintain the integrity of the system. An organic system through the operation of its steady state, controls the transformation rate of substances and the input of substances to be transformed such that the organization of the organic system is maintained or increased over time.

The elementary output of the organismic system to its environment is substances or waste products, resulting from the transformation of input which the system does not need to maintain its organization and internal integrity. An organism acts upon its environment such that it increases the environment's entrophy by taking in organized substances, transforming them such that energy and substances are released for its self-maintenance, and releasing substances that are more disorganized and have lowered potential energy levels.

A second function of an organic system's output, and the one of greater interest in this paper, is that of controlling its input. A striking aspect of evolution is the emergence of mechanisms in organic systems which facilitate the system's achievement and maintenance of its steady states. In single cell organisms, the cell membrane controls the exchange of substances with its environment. More complex organisms demonstrate specialized cells which interact with their external environment and which create an internal environment for the cells in their corps. Thus the cells in the internal body of the organic system control their input from the internal environment by their membrane permiability and the characteristics of the internal environment are controlled by the actions of the external "skin" cells. Higher order organisms demonstrate "homeostatic" mechanisms which control the internal environment at relatively constant levels of certain chemicals, such as blood sugar and oxygen (Cannon, 1932).

A similar evolution of mechanisms to exert control on the organism's external environment is apparent. Motility, demonstrated even by the ameoba, controls external environmental conditions and variations by allowing the organism to translocate. More complex organisms demonstrate fixed behavioral patterns which allow the organism to translocate with environmental variations and to operate on the environment to maintain their immediate external environment within ranges that allow the maintenance of their internal states. These inborn behavior patterns are usually described as instincts (Lorenz, 1950; Tinbergen, 1951). Ashby (1960) has highlighted the evolution of more flexible mechanisms allowing the organism to adapt its external behavior patterns to the conditions of the environment and thus more effectively control the range of environmental variation. While the end sequence of chains of behavior may be instinctual (such as eating or copulating; Lorenz, 1950; Tinbergen, 1951), the organism's actions preceding the end sequence can vary to accommodate existing environmental circumstances. In other words, while the end of a sequence of behavior remains fixed (instinctual) the means to the end can vary according to the contingencies of the cirmumstances. For example, a fox can vary its actions in procurring a rabbit in accord to the deviousness of the rabbit, while his eating of the rabbit (once caught) may be a fixed, instinctual act. According to Ashby, the fox is capable of learning to catch the rabbit from the rabbit; the fox is not dependant on a fixed inborn "rabbit catching" behavior pattern.

In certain higher level organisms, biological evolution has resulted in multi-organism systems which control and maintain the member organism's environment with a range in which the individual organisms can survive. Recent ethological study of baboons, for example, has shown how these organisms, while physically much less able than many other organisms in their environment, maintain near invulnerability from their enemies by a system of social specialization in which the males are systematically trained from birth to assume protective roles in their adulthood. The presence of an enemy is immediately met by the stronger males organized in a fighting cadre while the weaker members of the troupe retreat to safety. Likewise, elk, bison, and other mammals seek protection in a "herd" with the stronger members assuming the protection of the weaker. In the multi-organism system, the individual member's environment is partially the product of his social system, and he maintains himself through participation in maintaining the multi-organism social system.

Homosapiens operate within the environmental range provided by the social system or culture and the individual's survival depends on the maintenance of the multi-person system. Individual organisms are shaped by the multi-organism system to perform the many functions necessary to maintain the system. The individual's behavior and motivations are a function of the evolving characteristics of the system into which he is socialized or, more specifically, are a function of the component part or parts of the social system into which he is socialized (Sahlins & Service, 1960).

The human organism is, then, an open system with many complex steady states which are attained and maintained through internal and external behavioral mechanisms which operate to control its environment. The organism is socialized into a cultural system such that his self-maintaining behavior contributes to the maintence of the culture, the survival of which his own survival depends on. The individual's functioning is a result of the symbiotic relationship between his characteristics as an open system striving to control his environment for self- maintenance and the demands or forms of the cultural environment of which he is a part.

The marked acceleration of bio-social evolution in the last several thousand years suggests that natural selection has increasingly become more an active than a passive process in which the bio-social systems which have attained more effective control of the environment actively destroy less developed systems. A case in point is the destruction of the American Indian cultures and most of the individuals in them by the invading Western European cultures which had much higher levels of technological control of the environment (Brown, 1971). Social systems that survive today tend to emphasize thechnical development which yields increasing environmental control, the products of which account for their success in competition with less development-oriented systems.

Model of an Organismic System

Figure 3 below illustrates a model of an open organismic system "O" composed of

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Insert Table 3

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elements E = e_1, e_1 .... e_8 (excluding e_e) and P = p_{e1}, p_{12}, p_{23} .... p_{87}, p_{8e} defined as O = (E,P). The elements are as follows:

e_e: Environment - not part of the system but connects with it via p_{e1} and p_{8e}.
e_1: Input terminal - connected to the environment e_e and Input Memory.
e_2: Input Memory - connects Input and the Steady State elements via the Input-Steady State Connector.
e_3: Input-Steady State Connector - connection of the Input Memory and the Steady States and among the Steady States.
e_4, e_5, e_6: Steady States - connected to the Input Memory via the Input-Steady State Connector.
e_7: Output Memory - connected to the Input Memory and the Output terminal.
e_8: Output terminal - connected to the Output Memory.

The environment, denoted e_e, is the field in which the organic system exists and is not part of the organic system. The organism is connected to the environment through e_1 and e_8. The environment has impact on the organism through e_1 and the organism has impact on the environment through e_8. The environment acts as a feed-back loop for the organism in that the effects of the organism's output are transmitted through the environment to its input.

Element e_8 is the response terminal of the organism and the output vector is indicated by $\vec{R}(p_{8e})$. The output vector is hypothesized to have three components symbolized by $\vec{r}_r$, $\vec{r}_e$, and $\vec{r}_a$, receptance output, effectance output, and affectance output respectively. Receptance outputs are orientations of the input element (e_1) to control the input element's scanning and focusing on outputs of the environment and of the organism. Receptance outputs are basically attention responses (outputs). Effectance outputs (responses) are mechanical movements of the body parts of the organism which alter its relationship to the environment and which can effect change in the environment such as the generation of sound waves, movement of gases, and translocation. Affectance output (responses) are changes in the smooth muscles and glands of the organism which indicate the conditions of the steady states (e_4, e_5, and e_6) of the organism to the organism. Affectance responses are tied to the motivational arousal of the organism.

The input terminal is element e_1. The total input to the organism from its environment is indicated by the input vector $\vec{S}(p_{e1})$. The several components of the input vector are indicated by $\vec{s}_{r:e}$ and $\vec{s}_e$. The $\vec{s}_{r:e}$ input vector component represents the environmental variation created by its output vector $\vec{R}$. As mentioned earlier, the environment as a medium transmits feedback to the organism of the impact of its output on the environment, revealing the current state of its output to the organism. In other words, the organism is an object in its own environment. Output-controlled environmental variation is described separately because of the organism's dependence on controlling its input from the environment to achieve its own maintenance. The second component of the input vector is $\vec{s}_e$ which represents environmental variation (input) which is independant of the output vector. It is obviously important to the organism to discriminate between input dependent and independent of its output vector. This discrimination is not assumed to be innately available to the organism but to the result from experience and causal inference.

Elements e_4, e_5, and e_6 are the steady states of the organism which, through connector element e_3 comprise the steady state system within the organismic system. Three steady states are shown arbitrarily to illustrate the system characteristics of theorganism. Even simple organisms undoubtedly have many more than three steady states. Steady states are chemical transformation processes basic to the physiological integrity of the organic system. They can be variously described by and related to oxygen level, blood sugar level, water level, and levels of other chemical substances. Steady State-like mechanisms may also be basic to instinctual behavior such as sexual activity and "herd" affiliations.

Steady states are viewed as the arousal or motivational base for the behavior of the organism. That is, changing levels of transformation lead to the activation of the organism's output mechanisms to obtain and maintain adequate input. The ongoing nature of transformation implies an ongoing activation of the organism's output and input mechanisms. The steady states are connected to input and each other via the connector element e_3. The interconnection of the steady states allows for the observation that organisms' activities are integrated. An organism does not scatter its output efforts in pursuit of multiple diverse input at any one time as would be implied by the existence of diverse steady states needing attention but, rather, the organism tends to focus on a few pursuits at any one time. This implies the concept of motivational centrality (Von Bertalanffy, 1968, pp. 56-75) which will be explored later.

Input Memory element e_2 receives input from the Input terminal e_1 and the Input-Steady State Connector e_3, and outputs to the Input-Steady State Connector e_3 and the Output Memory e_8. Input Memory stores information of the input the system has received and the impact of that input on the Steady State system (via p_{32}). We can hypothesize that the basic association of input and impact on steady states is by temporal contiguity. It is apparent, however, that organisms with larger memory capabilities mediate input-steady state impact over long temporal lags. Skinner (1938, pp. 52-55) suggests that meditation over long temporal delay is accomplished by defining the input as long chains of events. In higher level organisms, meditation probably is accomplished through symbolism, which will be discussed later.

In an inverse way, Input Memory provides directional control for the organism's output in the event of steady state activation. When steady-state deflection from optimum level occurs, the organism's output is directed to achieving input which was formerly associated with deflection correction. This "desired" input becomes a guiding "image" of the organism's actions as suggested by Miller, Galanther, and Pribram (1960) and their conception of TOTE units.

Output Memory element e_7 obtains input from the Input Memory element e_2 and the Output terminal e_8 and outputs to the Output terminal e_8. Output Memory stores the organism's experience of the impact of its output on its input. Such association is basically by temporal contiguity. Parallel to the above argument, more competent memory elements are probably capable of long range mediation between output and impact on input. Output Memory receives feedback on the impact and form of the system's output via environmental mediation to its input through the Input Memory. It also receives feedback on the topography (form) of the system's output mechanism from sensors in the output mechanism via connection p_{87}, referred to as proprioceptive feedback. The double sources of feedback on its output and on the environmental variation associated with its output increases the organism's capability to infer a causal connection between output and environmental variation and thus facilitates its efforts to shape its output to produce desirable input.

Output Memory stores the impact of output on input and, in the inverse use of the stored information, directs the organism to produce output which has been associated with the input image associated with needed steady state corrections. In other words, when the organism suffers activation from its steady states, Input Memory provides a guiding image of corrective input and Output Memory provides an output topography which, in the past, has been associated with input fulfilling the guiding image.

System Behavior

From the external observer's point of view, the organism can be seen as receiving input from its environment and delivering output to its environment. Let us denote input as stimulus with the symbol $\vec{S}$ and output as response with the symbol $\vec{R}$. Stimulus and response are conceptualized as having direction and magnitude, thus the vector notation ($\rightarrow$). The organism's behavior can be conceptualized as its transformation (f) of stimulus to response, such that the behavior of an organism can be described as

(1) $$\vec{R} = f(\vec{S}).$$

As was noted above, the stimulus and response vectors are made up of component stimuli and responses, with each component distinguishable by its source or its meaning or impact on the organism or the environment. The behavior of an organism can be classified into two categories based on the correlation of the relationship between stimulus and response. Invariant relationships are classified as combinatorial behavior, and relationships which vary in time are classified as sequential behaviors (Kliv & Valach, 1967, p. 32).

Combinatorial behavior can be described as instincts or reflexes, in which a given component response always results from a given component stimuli pattern. Three different reflexes can be donoted as

(2) $$\begin{aligned} \vec{r}_1 &= f_1(\vec{s}_1, \vec{s}_2, \ldots \vec{s}_n) \\ \vec{r}_2 &= f_2(\vec{s}_1, \vec{s}_2, \ldots \vec{s}_n) \\ \vec{r}_3 &= f_3(\vec{s}_1, \vec{s}_2, \ldots \vec{s}_n) \end{aligned}$$

where each response component is an invariant and different function of the components of the stimulus vector. Many of the behaviors of organisms in constant environments have the character of combinatorial behavior and are described as habits or over-learned patterns. Ethologists (Lorenz, 1950; Tinbergen, 1951) claim that all behavior chains of organisms end with combinatorial, reflex behavior. While the rest of the behavior in the sequence can vary for a variety of reasons, the final response-stimulus combination is invariant, inborn and instinctual. Combinatorial behavior allows an organism a wide range of responses to a wide range of stimuli, but does not allow an organism to adjust its responses to its changing internal states or to benefit from its experience.

Sequential behavior occurs when an organism's response to a stimulus changes over time. To account for this shifting of response in the face of a constant stimulus, let us describe the behavior at time t as

(3) $$\vec{R}_t = f(O_t, \vec{S}_t).$$

where O stands for the internal state of the organism at time t. If we note the passage of time to the next observation as $t + \Delta t$, we observe

(4) $$\vec{R}_{t + \Delta t} = f(O_{t + \Delta t}, \vec{S}_{t + \Delta t}).$$

If $R_{t + \Delta t} \neq \vec{R}_t$ and $S_{t + \Delta t} = \vec{S}_t$, we can infer that $O_{t + \Delta t} \neq O_t$, and that we are observing sequential behavior. We can further assume that the new value of the internal state of the organism is a function of the previous value of the internal state as affected by the input of $\vec{S}_t$ and the passage of time Δt. Thus

(5) $$O_{t + \Delta t} = f(O_t, \vec{S}_t),$$

and the time Δt can be called the reaction time of the internal state of the organism. It was argued earlier that the organism deployed its response mechanisms to control its input in order to attain and maintain an optimal level of transformation in its steady states. The organism's response mechanisms are activated by non-optimal levels of steady states, directed by its memory of previous input correlated with corrective input (image) and engaged in a form (topography) that was previously associated with attaining the desired input. The internal characteristics or states altered over time as in formula 5 above are activation, image, and topography. Activation stems from the operation of the organism's steady states and, via the input-steady state connector, is attached to an image in the Input Memory. Following Lewin (1938) we can combine activation and image in the construct of psychological force symbolized by $\vec{F}$. Psychological force is represented as a vector in that it demonstrates both direction (from the image) and magnitude (from the activation). Psychological force directs the organism's activity to achieve certain inputs and controls some aspects of the intensity of the organism's response, such as the temporal longevity of the response, in that responding persists until input is achieved which matches the guiding image, or until achieved input alters the activation or image in some other way and thus alters the psychological forces operating on the organism. Due to the multiple steady state activations acting on an organism at any one time, and the multiple images associated with the multiple activations, an organism is directed at achieving several inputs at any one time. The multiple psychological forces acting on an organism at any one time combine to a resultant psychological force symbolized by $\vec{F}*$ so that

(6) $$\vec{F}* = f(\vec{F}_1, \vec{F}_2, \ldots \vec{F}_n),$$

the function (f) of which may be vector addition. Pertinent here also is the concept of steady state centrality, to be discussed shortly, which limits the number of psychological forces acting on the organism at any one time.

Response topography or form is determined by the organism's experience of what response is associated with achieving input matching the guiding image. Response topography can be symbolized by $\vec{T}$, which is also represented as a vector entity because the response is directed to some end and demonstrates magnitude. More aspects of the magnitude of a response are controlled by $\vec{T}$ then $\vec{F}$ in that the dimensions of response such as speed, loudness and forcefulness are important aspects of the response's achievement of a desired input.

We can now indicate rather completely the variables of behavior as follows:

(7) $$\vec{R}_t = f(\vec{F}^*_t, \vec{T}_t, \vec{S}_t)$$

where $\vec{F}^*_t$ and $\vec{T}_t$ represent the internal characteristics of the organism which contribute to the response $\vec{R}_t$ at time t and $\vec{S}_t$ represent the contribution of the environmental variation impinging on the organism at time t. The formulation represents the organism's sequential behavior from the point of view of the external observer. From the organism's viewpoint, we can more correctly denote behavior as

(8) $$\vec{S} = f(\vec{R})$$

or more subjectively,

(9) $$\vec{S} - f(\vec{F}^*, \vec{T})$$

The organism is concerned with controlling its input $(\vec{S})$ with its output $(\vec{R})$ in service of its needs (activation) via its accumulated experience (image and response topography) or $\vec{F}^*$ and $\vec{T}$. This formulation suggests that the difference between behavioristic and humanistic psychologies is not so much the variables they deal with as the observational vantage point they begin from: the external observer (behaviorism) or the behaving organism (humanism).

The three internal characteristics of activation, image and topography combining in the variables of psychological force $(\vec{F})$ and topography $(\vec{T})$ suggest three identifiable classes of sequential behavior: random activation, trial and error, and direct effectance. <u>Random activation</u> sequential behavior occurs when the condition of a steady state of the organism activates the organism's response mechanisms, but the memory elements of the organism do not contain an adequate image of a required input condition to correct the disbalance of the steady state and as a result (or in addition) lack of knowledge of a response topography which would create the unknown input. Under these conditions the organism can be observed to behave in a random pattern, which Lewin (1938) has described as restlessness. Internally the organism probably experiences discomfort and confusion.

<u>Trial and error</u> sequential behavior occurs when an organism experiences an activation and has an image of the required input to remove the activation, but lacks a memory of a

response topography which would create the required input. Under these conditions, the organism shifts from one response topography to another until the desired stimulus condition is created. This kind of behavior clearly demonstrates the equifinality or purposefulness of the organism's behavior in the sense that, from a wide variety of conditions, a common result is created. Of course what we are describing is the continued activation of the steady state system and the organism's response mechanisms until it manages to produce the input as required by its guiding image. Psychologists have studied trial and error behavior a great deal and describe the organism's behavior as coming under the control of the situation the psychologist created as the organism comes to respond according to the established contingencies. From the organism's point of view, and from a psychological point of view, it is more correct to say that the organism has, through systematic variation of its output, obtained control of its input. That is to say, the organism has achieved control of the situation in spite of the deviousness of the psychologist. The reason the psychologist's manipulations have had an effect on the organism's behavior is that the organism was actively seeking to gain control of the environment's output to him.

<u>Direct effectance</u> sequential behavior occurs when the organism experiences activation from a steady state, obtains an image of an input which would satisfy the activated steady state, and obtains a response topography which will create the required input. The organism subsequently responds directly, effects the required input, and terminates the behavior. This behavior can be described clearly and philosophically correctly as intentional, purposive and deliberate. Much of human behavior and the behavior of organisms in known environments is direct effectance behavior. The symbolic system maintained in multi-organism systems greatly increases the amount of behavior which can be described as direct effectance through symbolic instruction and training which passes to the organism knowledge of the relationships between responses, various environmental conditions, and their impact on the organism. The role of symbolism in behavior is developed further below.

The open system model of behaving organisms presented here suggests the following statements of the behavior of organisms:

1. An organism is an open system which transforms input or stimuli into output or responses.
2. An organism actively operates on its environment to control its input.
3. An organism uses its response capabilities to control or generate its input.

4. An organism processes its input in accordance to the relevance of the input to its steady states, i.e. the input's motivational relevance to the organism.
5. An organism guides its output so as to control its input such that the input will maintain its steady states.

Learning, Performance and Attention

The above model of the behaving organism implies the familiar distinction between learning and performance (Kimble, 1961, pp.4-5) in that learning is association through temporal contiguity of variation of environment, change in steady states, and response topography. Attention (receptance responses) controls learning in that learning is a function of the observation of temporal contiguity between steady state variation, input, and response topography. Attention is directed to input which has an impact on steady states. That is, the organism is most concerned with observing environmental variation which is related to its motivational or steady state system. Organisms tend to note environmental and response variations which are motivationally relevant.

Centrality

The behavior of organisms is focused or centralized. Organisms focus their attention on a few endeavors at one time; they do not run in every direction at once. This is curious when one considers the large number of steady states a single organism must attend to at all times to maintain himself. Von Bertalanffy (1968, pp. 56-75) has proposed that the steady states of organisms are interconnected such that the activation value of any one steady state depends on the values of all others at that time. This interconnection is indicated in the model of an organism through the Input-Steady State Connector element e_3. By the interdependancy of steady states, the organism's activation is directed at a few steady state disbalances at any time rather than to all of them. The steady states must have some kind of hierarchy of importance such that disbalance on higher-order steady states removes activation on lower-order ones. Likewise, greater deviations must have more weight than smaller deviations. For example, an organism threatened with overwhelming heat will lose its interest in sex in service of finding a way of decreasing the heat. A very hungry organism is more interested in finding food than avoiding uncomforting but not extreme heat. The current value of a steady state activation thus must have two sources, the current disbalance of the steady state, and the disbalances of all other steady states. These circumstances can be denoted by a series of simulataneous differential equations giving the instantaneous values of the steady states, where the values of states are noted as v_1, v_2, v_3, ... v_n, as follows:

$$\frac{dv_1}{dt} = f_1(v_1, v_2, v_3 \ldots v_n)$$

$$\frac{dv_2}{dt} = f_2(v_1, v_2, v_3 \ldots v_n)$$

$$\frac{dv_3}{dt} = f_3(v_1, v_2, v_3 \ldots v_n)$$

$$\frac{dv_n}{dt} = f_n(f_1, v_2, v_3 \ldots v_n)$$

Determining the values and interaction of these equations requires much experimental research. An illustrative example of behavioral data is graphed in figure 4 to show the activational interrelationships of four "steady states" as expressed by four behaviors— exploration of environment, eating, deficating and breathing. Examination

Insert Figure 4 about here

of the time-plots of the behaviors suggests that the behavior "breathing" was of highest order of centrality and not incompatable with the other behaviors in that it occurred throughout the period of observation. The rate of breathing was correlated with the other behaviors, most notably environmental exploration. The dominant behavior throughout the period of observation was environmental exploration, but it appeared to be incompatable with both eating and deficating and of a lower order of centrality as it completely terminated during eating and deficating. Deficating appears to have been the second most central behavior as it consumed a greater proportion of the organism's activities when it occurred. Deficating always consumed 80% of the organism's activity when it occurred, while the maximum proportion for environmental exploration was 75% and for eating was 70%. Apparently, the organism was engaged in other behaviors than those plotted, especially at $t_{8:30}$ and $t_{12:30}$, as the proportion of total activity accounted for approached 100% only during periods of defication. If we assign symbols for the psychological forces acting on the organism for breathing, eating, deficating and environmental exploration as $\vec{F}^*_b$, $\vec{F}^*_e$, $\vec{F}^*_d$, and $\vec{F}^*_{ex}$ respectively (we can ignore "T" as we have no information on the response topography of behaviors) we can describe the organism's behavior at any time t as:

$$\vec{R}_t = f_t(\vec{F}^*_{bt}, \vec{F}^*_{et}, \vec{F}^*_{dt}, \vec{F}^*_{ext}, \vec{S}_t)$$

By dropping the forces for behaviors which do not occur, we can describe the organism's behavior at t_8 by

$$\vec{R}_{t8} = f(\vec{F}^*_{bt8}, \vec{F}^*_{et8}, \vec{S}_{t8})$$

and similarily for any other time t. We could determine exact equations to describe the interrelations of the behaviors over the total time period, and calculat differential equations for any time increment Δt which would describe the organisms response change as a function of the changes of the psychological force's operation on the organism. Careful observations and mathematical work of this sort would yield empirical st tements of the relationships among the variables of behavior and the impact of loadings of these variables on the responses of the organism. Unfortunately, psychologists have done very little plotting of behavior over time such that the centrality inter-relationships of the organism's motivations or steady states could be estimated. An exception is the work of Barker and his associates (Barker, 1963).

Chaining and Symbolism

We have described organisms as seeking to gain control of inputs (stimuli) which affect their steady states through a primitive causal theory of the controlling impact of their responses on input. A similar contiguity theory of cause can be applied to the relationships among stimulus conditions in which a particular environmental condition can be seen as leading to or causing a later environmental condition. If the latter condition relates to the organism's steady states, an organism possessing sufficient memory capabilities will use his response mechanisms to gain control of the former condition. Thus organisms operate to produce conditions which will allow them to operate in such a way as to maintain their steady states. The length of the chain of anticedent environmental conditions to be controlled is limited only by the memory ability of the organism, the accuracy of his causal inference, and the objective relationships among the environmental conditions in the chain. The history of human civilization documents an increasing chain of events between biological survival and human activity. Chaining becomes increasingly interesting when one considers the impact of conditions which makes the maintenance of several steady states possible. Chaining is the basis of research on token economics in chimpanzee colonies (Wolfe, 1939), building response repertoires in autistic children as a method of treatment (Ferster & DeMyer, 1962) and token economics in mental hospitals (Ayllon & Azrin, 1968).

Closely related to chaining is the behavioral phenomenonof symbolization. Language is a behavior system which has been developed and is maintained by social systems (Skinner, 1957). Language allows members of the system to describe their observations to each other. It serves as a linkage among the elements or parts (individuals) of the social system. Members of a society are systematically taught symbolic behavior so that they can learn relationships among events through the use of the symbolic system, and they can describe their own learning and experiences to others. Through the use of symbols, members of the social system learn the motivational relevance of events and how to control and create events without directly experiencing the events. If you will, through the use of language, the organism can directly access his memory elements. The symbolic system also allows organisms to develop elaborate causal chains of environmental events which, at the end, relate to their steady states. They need not directly observe the linkages between the environmental events, nor necessarily remember them if a script system is available and they have been taught how to use it. Symbolism vastly increases the direct effectance behavior of the organism in that he can learn of the expected impact of environmental input and how to achieve environmental input without going through random activation and trial and error behavior.

The Behavior of Persons

The first section of this paper described the evolution of external behavior mechanisms which allow the organism to control his input as progressing from simple motility to instinctual behavior patterns, learning mechanisms, and finally to multi-organism systems. Persons are socialized into multi-organism systems and derive their survival from participation in the systems. An individual's behavior serves both the objective of continuing his own survival as a biological entity and the objective of maintaining his social system. All persons have highly similar organic needs and characteristics and the needs must be satisfied or met if the persons are to survive. At the same time, the forms in which persons' biological needs are met are dictated by their social system and, within a social system, individual variation results from the specific socialization experiences of the individual and the roles or functions he is induced to perform within the system. For example, while persons can survive from a great variety of food stuffs, the foods a particular individual will eat depends upon the range of foods seen as fit from his cultural perspective. Sexual gratification can occur through erotic imagery or frictional stimulation provided by any number of similar or opposite sexed individuals as well as by self or inanimate objects. Yet the range of acceptable sexual performance is narrowly defined and heavily monitored. Defication can occur in numerous ways, yet acceptable means for any person is narrow and socially defined. Likewise, the rearing and socialization of youth can be carried out in a wide variety of ways as far as the youths are concerned, but only a few methods of child rearing are seen as possible or correct in any particular society. A further example of societal variation is the emphasis on achievement in some systems, while other systems emphasize the maintenance of social cast.

The psychological force constructs introduced earlier to denote the activations and direction of a person's behavior are jointly determined by the biology of the person and the environmental input he experiences as related to his activations. The inputs a person perceives as potentially satisfying his activational needs are controlled by his social system. Thus the psychological forces operating on a person, and his subsequent responses, are different in different social systems because the goals to be achieved for steady state maintenance vary among social systems. A catalogue of the common motivations or psychological forces of persons in a society would result in a list of what that social system teaches its members to be the proper ways of behaving. In sum, the goals, stimulus patterns, or images persons seek to produce by their responses are culturally or experientially relative and organically universal.

The individual is socialized into his functional roles in a society all of his life. A necessary part of his socialization is the inculcation of a behavior system which can be used to describe events of the external world such that others can transmit knowledge of events in the environment to him without his directly experiencing the events. Through symbolism, individuals are taught what patterns of events are appropriate, desirable, and to be sought, and what patterns are not appropriate, undesirable, and forbidden, largely without the individual's testing the validity of the claimed relationships among events. Thus, the symbolizing person is provided images and associations among stimulus (input) events, response events, and his internal states, without random activation or trial and error behavior. These images, or patterns of analyzing and evaluating stimulus events, are directly and symbolically chained into the memory elements of the person. Thus the person's effectance behavior is guided by symbolically derived patterns which are chained to primary patterns. The person's emotional affectance responses are also tied to his chained, symbolically derived interpretations of the significance of events. Much of a symbolizing person's behavior is determined by the symbolic interpretations he makes of events. A rather rudimentary example of the symbolic control of psychological forces and of behavior is seen in an individual's response to an oncoming vehicle. Very few persons have experienced the motivational significance of being hit by an automobile, yet most persons have been thoroughly coached by parents and others of the fearsome effects of such a collision. Their belief in these fearsome effects results in strong and quick responses to avoid such a collision. While this example is obvious, less obvious are students' reactions to competitive situations, clients' reactions to interpersonal conflict, and psychologists' reactions to insignificant salary increases. We believe such events have certain motivational significance and our responses are determined by that belief.

In terms of the person's functioning, successful socialization requires that the guiding images, inculcated to provide the directional component of motivation, provide for steady state maintenance, and that alternative undesirable input patterns and images which could potentially provide the person with steady state maintenance are made inaccessible either through ignorance or by making them dangerous so the person will not stray into them. Successful socialization creates deep behavioral "channeling." Desirable or acceptable patterns must be clearly differentiated from the undesirable.

Changing Persons' Behavior

Changing person's behaviors entails changing their symbolic interpretations of the motivational significance of input (their psychological forces), changing their means of attaining input (their response topographies) and/or changing their environments. Changing person's symbolic interpretations of the motivational significance of input involves altering their chain of perceived causal relationships among environmental events and the perceived motivational significance of those events, by adding to the chain, subtracting from the chain or disrupting the perceived significance or causal relationship among the events in the chain. Providing the person information which differs from or adds to his previous information about the nature of event relationships or the motivational significance of events, through symbolic instruction or new experiences, will change his behavior if he incorporates the new information in his memory elements. Instructing an individual symbolically or experientially on how to use his response mechanisms to produce new or different environmental variation or input will alter his behavior if he incorporates the new information in his memory elements. Changing the nature of relationships among events in a person's environment will lead to his changing his behavior as he strives to control his environment to serve his needs. Effective changing of behavior requires a sound technology of information presentation either symbolically or experientially which is attuned to the nature of the organismic system and the characteristics of the society which the individual's behavior reflects. In concept, behavior change is relatively simple and straight forward. In practice, a vast array of details is required which identify the precise behavior change to be accomplished- the individual's motivational repertoire to be affected, the exact nature of the response topography to be altered, and the environmental events to be rearranged.

In verbal counseling and psychotherapy "in the office," altering persons' behavior according to the model of behaving persons presented here falls into two distinguishable phases, diagnosis of the dynamics of the client's problem and intervention into the dynamics. Diagnosis begins with a thorough description or elaboration of the behavior pattern the client seeks to change. We must seek answers to questions such as: Is he suffering from anxiety (affectance) responses from which he seeks relief? Is he frustrated in his inability to achieve certain goals? Is he unable to determine what goals or images he could obtain which would bring him satisfaction which he now feels is lacking (activation without image)? Does he find his responses (topography) in certain situations to be inadequate for what he wishes to achieve? All the behavior patterns clients desire to alter are imbedded in specific stimulus (input) patterns and these stimulus patterns need to be elaborated as completely and objectively as possible. Target variables are those responsible for his transformation of a specific stimulus pattern into an undesired response pattern, or responsible for his response patterns that are generating undesired inputs or environmental events. In order to deduce symbolic transformations which may be basic to the problem, we must know what input is being transformed into what output, as well as the inverse. The elaboration should proceed through the full range of incidents of the transformation so as to deduce what stimuli imbedded in the input patterns are being transformed into the undesired responses or the inverse, with the analysis aimed at revealing perceived causal relationships. Having thoroughly described the problematic input and output, the next problem is to deduce the variables responsible for the transformation of input into undesired responses or of responses generating undesired input. Transformation variables are largely chained symbolic patterns in adult persons that relate to the psychological forces directing the client's behavior. The nature of the transformation is revealed by the relationships between input and output. Causal analyses along the lines suggested by Hieder(1958) and Strong (1970) will aid the counselor to suggest the goal or guiding image of the psychological force. Alternatively, the client may "know" his objectives or goals, but be unable to implement them with his existing response topography repertoire. The objective of diagnosis is to isolate the target pattern of input and output and, from analysis of this pattern, deduce the dynamics creating the unwanted transformation in terms of sources of activation and direction (i.e. the psychological forces operating) and the adequacy of emitted response patterns in generating desired input.

Treatment or intervention to alter these dynamics can take many forms, but the most direct involves symbolically operating the symbolic transformations the client is found to be using. If the client's interpretation of environmental events is activating a psychological force leading to avoidance behavior and emotional responses, this interpretation can be directly altered using the procedures described by Ellis (1962) and Beck (1970). If the client's goals or images related to activities are vague or are incorrect (i.e. the symbolic goals or images do not satisfy the conditions of activation), they can be clarified by verbal description and elaboration, using procedures like those Gendlin(1964, 1969) describes, as well as more problem-centered cognitive discussion. As appropriate goals are derived, the client can be facilitated to emit new responses in the problematic situation using the power generated in the counselor-client relationship (Strong & Matross, 1973). Facilitating the client to overcome response topography deficits can be accomplished by modeling, vicarious practice, and instruction (Lazarus, 1966). Other procedures such as desensitization obviously have their place in intervening in the client's dynamics.

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FOOTNOTE

1. An earlier version of this paper was presented to a colloquium of the Department of Psychology, the Ohio State University, in May, 1972.

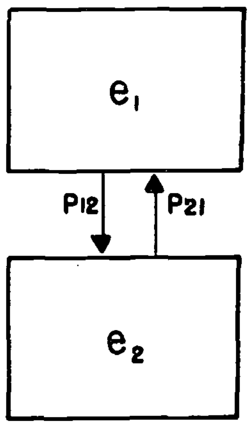

Figure 1. A System With Elements e_1 and e_2 Interconnected By P_{12} and P_{21} in a Field.

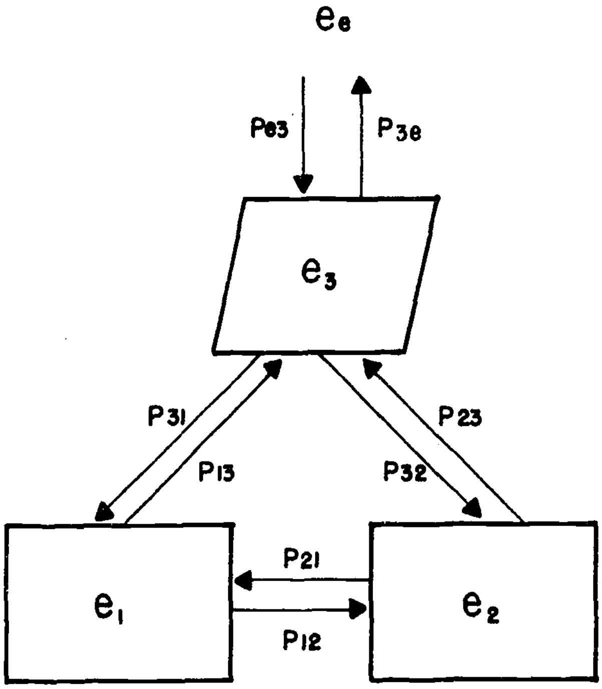

Figure 2. An Open System with Elements e_1, e_2, and e_3, Which Relates to a Non-system Element e_e Through Element e_3.

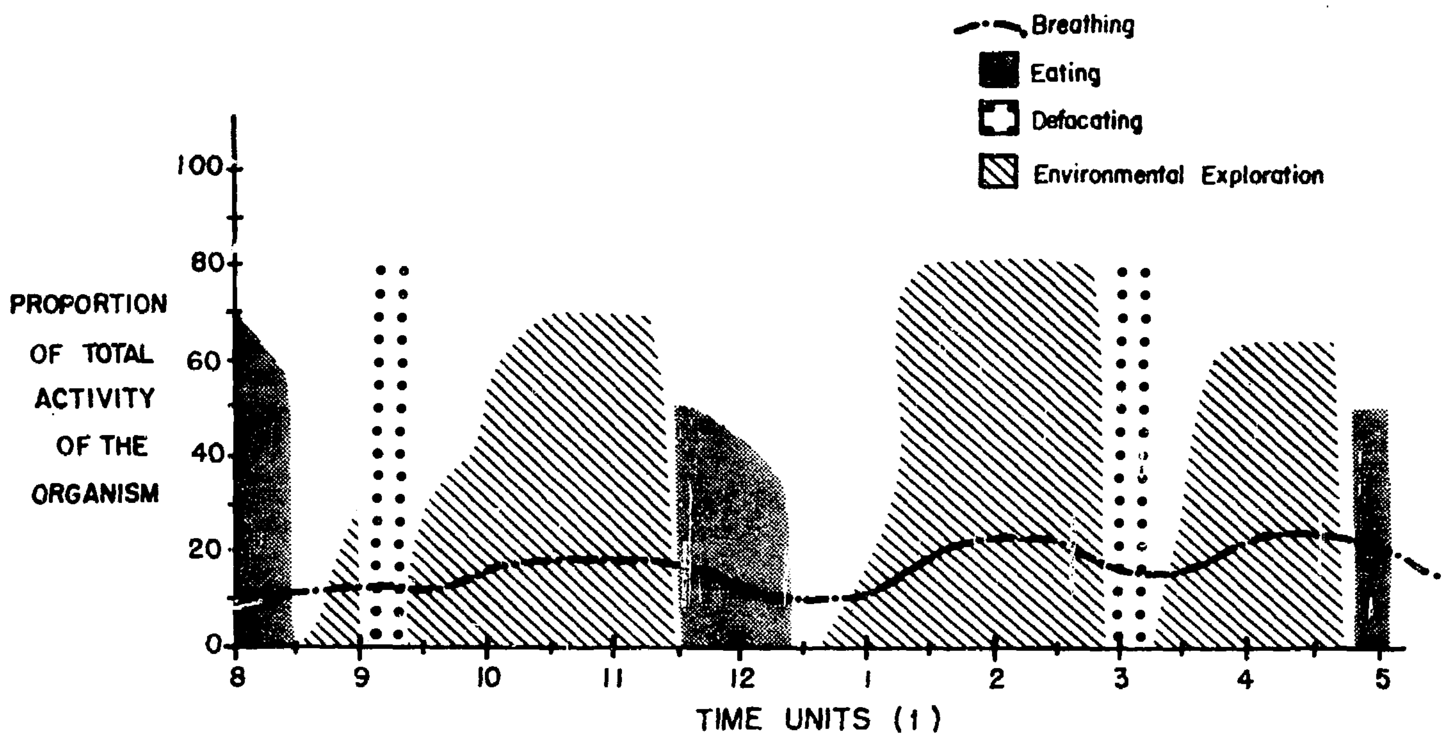

Figure 4. A Time Plot of the Proportion of an Organism's Total Activity Devoted to Breathing, Eating, Defacating and Environmental Exploration Behaviors.

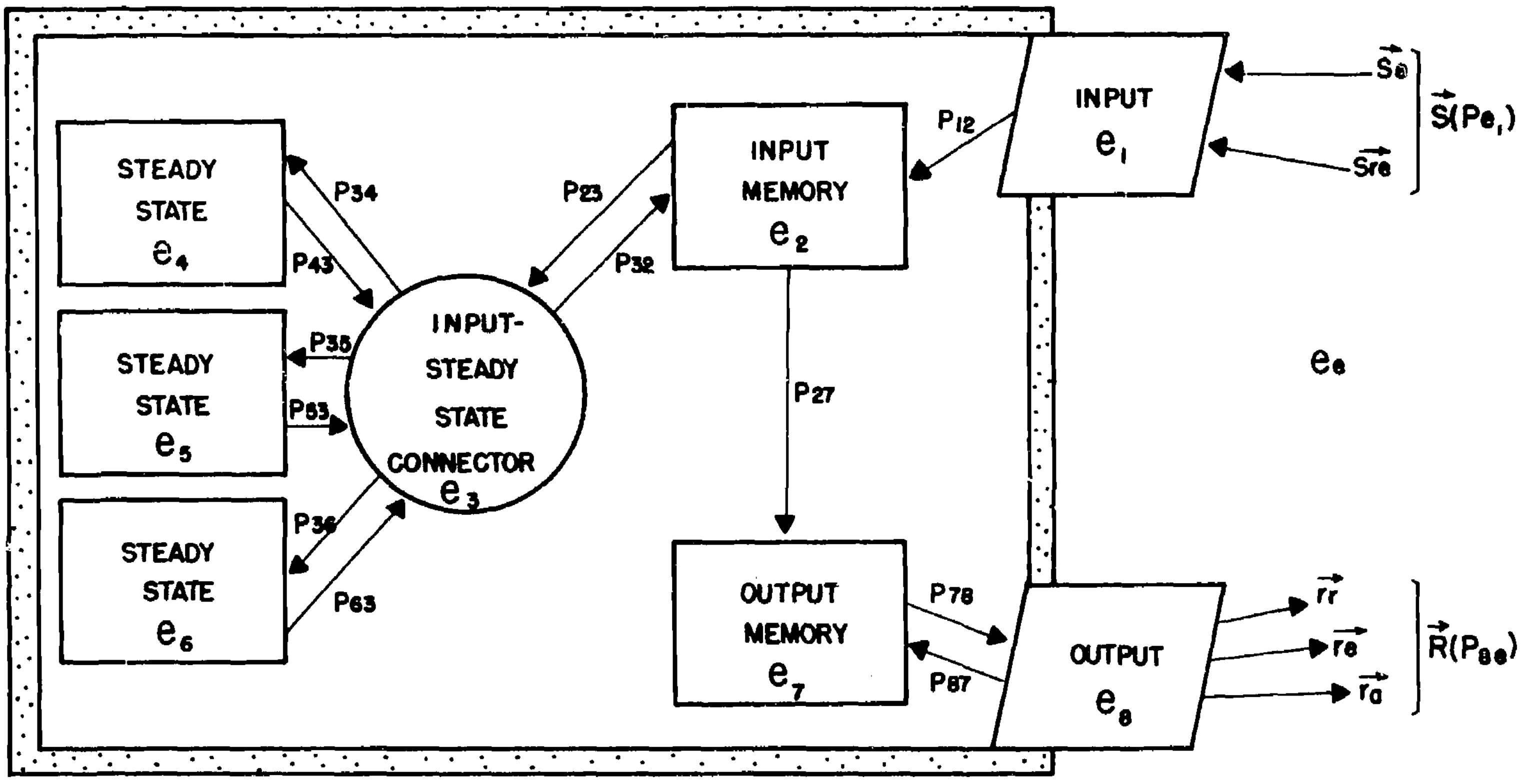

Figure 3. Model of an Organismic System.